COMMENTARY ON "THE USE OF THE ARTIFICIAL KIDNEY IN THE TREATMENT OF UREMIA"

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Fifty years ago, the diagnosis of kidney failure was, for the most part, a death sentence. Even people with otherwise reversible conditions, such as acute oliguria from rhabdomyolysis, had an extended convalescence and increased mortality due to the limits on nutrition imposed by anuria. Dr. Merrill's review is one of the first to describe a series of patients treated with the artificial kidney, the treatment known hereafter as hemodialysis. He specifically illustrated the efficacy of hemodialysis in supporting the conservative management of reversible acute renal failure and in palliating the symptoms of nausea, vomiting, anorexia, and weakness associated with the uremic syndrome of chronic renal insufficiency. Hemodialysis was not recommended if there was no electrolyte imbalance or no symptoms; it was not considered effective in hypertensive cardiovascular disease or nephrotic edema. Because of the need to treat patients with anticoagulants, those with gastrointestinal bleeding, subarachnoid hemorrhage, or other intracranial bleeding were also considered at risk for treatment with hemodialysis.

The most common indications for acute hemodialysis continue to be those cited by Dr. Merrill: the presence of uremic syndrome, a multisystemic syndrome involving the cardiovascular, neurologic, hematologic, and endocrine systems; hyperkalemia; and acidosis, with or without volume overload. However, the use of acute hemodialysis has expanded beyond Dr. Merrill's initial recommendations. It is now used to improve the outcome for cardiothoracic surgery patients with acute volume overload; for patients with refractory congestive heart failure;

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for patients with sepsis, for whom it is used to help remove damaging cytokines; and for other critically ill patients whose injured kidneys cannot keep up with the volume requirements of multiple medications and parenteral nutrition.[1-4]

Dr. Merrill vastly understated the success with which hemodialysis could be used to treat patients with both acute and chronic renal failure. Close to 200,000 Americans currently receive chronic hemodialysis, with the majority reporting satisfactory quality of life.[5] The decision to initiate dialysis is relatively easy when a patient has florid uremic symptoms and signs as described by Dr. Merrill. Now, however, subtler symptoms, such as changes in appetite, growth rate, mental status, and behavior, are enough to initiate dialysis, with resultant improvement in long-term patient outcome.[6,7] Dialysis can be used to improve the outcome for patients with renal failure and concomitant pericarditis, myocardial dysfunction, hypertension, uremic encephalopathy and peripheral neuropathy, bone disease, pruritis, and growth failure. Indeed, the complex interactions of multiple interrelated medical problems often necessitate dialysis before the GFR (glomerular filtration rate) declines to below 10 mL/min/1.73 m^2.

Efforts are being made now to assess the adequacy of dialysis in that simple correction of electrolyte disorders is routine but insufficient for the relief of uremic symptoms, restoration of good quality of life, and minimization of major organ system dysfunction. Many of these assessments involve reduction of serum urea (blood urea nitrogen, BUN) because urea, although not particularly toxic itself, does mirror other important toxins and is easily measured. However, much of the scientific basis for urea kinetics makes use of unsubstantiated assumptions (absence of recirculation of dialyzed blood, single vs. two-pool kinetics), making the calculations and conclusions somewhat suspect. Nevertheless, this approach has proven more reliable than subjective assessments by the patient or measurements of other functional studies (such as nerve conduction time). Chronic dialysis prescriptions aim to reduce urea by at least 60%, which is accomplished by the selection of appropriate dialyzer types, blood pump speed, and required dialysis time. This use of hemodialysis, coupled with the elimination of the anemia of chronic renal failure with erythropoietin and the reduction of secondary hyperparathyroidism with phosphate binders and activated vitamin D preparations, has added quality and years to the lives of patients who, without this marvelous intervention, would have died of renal failure. In addition, the use of growth hormone in children on dialysis has frequently restored normal or predicted growth rates despite the failure of the kidneys.[8]

The future of hemodialysis is of great interest to nephrologists and their patients. Morbidity from premature cardiovascular disease, amyloid and alumi-

num bone disease, and refractory growth failure are still prominent. Vascular access through arteriovenous fistulae and polytetrafluoroethylene grafts becomes limiting with time on dialysis. In the future, dialysis technology will attempt to reduce morbidity by better monitoring of patient parameters such as blood pressure, blood volume, and cardiac output to reduce intradialytic problems and perhaps shorten the time of dialysis. Improvements in dialysate composition to optimize ionic compositions for each patient should improve acid-base status, secondary hyperparathyroidism, cardiovascular stability, bone disease, and phosphate removal.[9] Computerization of the dialysis prescription should prevent some errors in technique, allow more-accurate calculation of dialysis adequacy, and facilitate more quality time for clinical care of the dialysis patient. Better high-flux dialyzers with more biocompatibility for humans should help to improve dialysis adequacy and further reduce complications.

Thus, Dr. Merrill's work will continue to influence patients with chronic renal failure heavily in the near future or at least until the widespread availability of kidneys for transplantation makes dialysis an obsolete therapy. With regard to acute renal failure, dialysis will remain important, as Dr. Merrill foresaw. The incoming modalities of continuous veno-venous hemofiltration may provide more physiologic treatment of acute electrolyte disturbances and volume overload, but dialysis still remains an important component of this therapy as well.

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